

CLAIMS

1. A passive infra-red detector comprising:
 - at least three sub-detectors, each of said at least three sub-detectors being operative to receive infra-red radiation from a corresponding one of at least three sub fields-of-view, each of said at least three sub fields-of-view being exclusively defined by an optical element which does not define any other of said at least three sub fields of view, said at least three sub fields-of-view being angled with respect to each other, adjacent ones of said at least three sub fields-of-view being separated by a gap of no more than 30 degrees and at least one of said at least three sub fields-of-view having at least one of the following characteristics:
 - a) extending over no more than 45 degrees in azimuth; and
 - b) including not more than three azimuthally distributed detection zones; and
- 15 signal processing circuitry, operative to receive output signals from said at least three sub detectors and to provide a motion detection output.
- 20 2. A passive infra-red detector according to claim 1 and wherein said at least three sub fields-of-view are substantially non-overlapping.
- 25 3. A passive infra-red detector according to either of claims 1 and 2 and wherein each said optical element is directed in a corresponding direction, the corresponding directions of said optical elements of each two of said at least three sub-detectors being different.
4. A passive infra-red detector according to any of claims 1 to 3 and wherein said optical element comprises a non focusing optical element.
- 30 5. A passive infra-red detector according to claim 4 and wherein said non-focusing optical element comprises a reflective optical element.

6. A passive infra-red detector according to any of claims 1 to 3 and wherein said optical element comprises a focusing element.

7. A passive infra-red detector according to claim 6 and wherein said focusing element comprises at least one of a reflective element, a refractive element, a diffractive element and a cylindrical optical element.

8. A passive infra-red detector according to any of claims 1 to 7 and wherein said azimuthally distributed detection zones have corresponding divergence angles and said gap has an angular extent which is less than or equal to twice the largest angular extent of said divergence angles of detection zones of said adjacent ones of said at least three sub fields-of-view.

9. A passive infra-red detector according to any of claims 1 to 7 and wherein said gap has an angular extent which is less than or equal to a largest azimuthal angle $A - 2B$ between any two adjacent detection zones of said adjacent ones of said at least three sub fields-of-view.

10. A passive infra-red detector comprising:
at least three sub-detectors, each operative to receive infra-red radiation from a corresponding one of at least three sub fields-of-view; and
signal processing circuitry, receiving output signals from at least two of said at least three sub-detectors and providing a motion detection output in response to receipt of said output signals; noting, within a predetermined first time period, multiple detections by one of said at least two sub-detectors and the absence of detections by another of said at least two sub-detectors and being operative to ignore future detections by said one of said at least two sub-detectors for at least a predetermined second time period.

30 11. A passive infra-red detector according to claim 10 and wherein said at least three sub fields-of-view are substantially non-overlapping.

12. A passive infra-red detector according to either of claims 10 and 11 and wherein said signal processing circuitry is operative to ignore said future detections only in a case where said multiple detections fulfill predetermined pre-alarm criteria.

5 13. A passive infra-red detector according to either of claims 10 and 11 and wherein said signal processing circuitry is operative to ignore said future detections only in a case where said multiple detections fulfill predetermined alarm criteria.

10 14. A passive infra-red detector according to any of claims 10 to 13 and wherein said signal processing circuitry is operative to extend said predetermined second time period in response to detections by said one of said at least two sub-detectors during the predetermined second time period.

15 15. A passive infra-red detector according to any of the preceding claims and wherein said signal processing circuitry is operative to note a sequence of receipt of said output signals by said at least three sub-detectors and to provide motion direction output based on said sequence.

20 16. A passive infra-red detector according to any of claims 1 to 14 and wherein said signal processing circuitry is operative to note a sequence of receipt of said output signals by said at least three sub-detectors and to provide motion path output information based on said sequence.

25 17. A passive infra-red detector according to any of the preceding claims and wherein said signal processing circuitry is operative to process said output signals according to at least one predefined criterion.

30 18. A passive infra-red detector according to claim 17 and wherein said at least one predefined criterion comprises whether a time duration between receipt of said output signals from adjacent ones of said at least three sub-detectors lies within a predetermined range of values.

19. A passive infra-red detector according to either of claims 17 and 18 and wherein said signal processing circuitry is operative to process said output signals according to said at least one predefined criterion by noting time durations of said output signals from adjacent ones of said at least three sub-detectors and providing said motion detection output at least when the ratio between said time durations is within certain limits.

20. A passive infra-red detector according to claim 19 and wherein said ratio is in the range of 0.5 to 2.0.

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21. A passive infra-red detector according to any of claims 17 to 20 and wherein said signal processing circuitry is operative to process said output signals according to said at least one predefined criterion by noting a time difference between receipt of said output signals and time durations of said output signals and to provide said motion detection output in response to receipt of said output signals from at least two adjacent ones of said at least three sub-detectors having respective time durations and a time difference therebetween, said time durations and said time difference therebetween having a time relationship therebetween which meets at least one predetermined criterion.

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22. A passive infra-red detector according to claim 21 and wherein said at least one predetermined criterion comprises whether a ratio between said time difference and at least one of said time durations lies within a predetermined range of values.

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23. A passive infra-red detector according to claim 21 and wherein said at least one predetermined criterion comprises whether ratios between said time difference and each of said time durations lie within a predetermined range of values.

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24. A passive infra-red detector according to either of claims 22 and 23 and wherein said predetermined range of values is based at least in part on divergence angles of at least two zones of two different ones of said at least three sub-fields-of-view corresponding to said at least two adjacent ones of said at least three sub-detectors.

25. A passive infra-red detector according to either of claims 22 and 23 and wherein said predetermined range of values is based at least in part on an angle between of at least two zones of two different ones of said at least three sub fields-of-view 5 corresponding to said at least two adjacent ones of said at least three sub-detectors.

26. A passive infra-red detector according to any of the preceding claims and wherein said passive infra-red detector is operative to receive radiation from a field-of-view having a field-of-view divergence angle of at least 45 degrees.

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27. A passive infra-red detector according to any of the preceding claims and wherein at least one of said at least three sub fields-of-view comprises a single coplanar azimuthally distributed detection zone.

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28. A passive infra-red detector according to any of the preceding claims and wherein at least one of said at least three sub fields-of-view comprises multiple coplanar azimuthally distributed detection zones.

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29. A passive infra-red detector according to any of the preceding claims and wherein at least one of said at least three sub fields-of-view comprises a single vertically distributed detection zone.

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30. A passive infra-red detector according to any of the preceding claims and wherein at least one of said at least three sub fields-of-view comprises multiple vertically distributed detection zones.

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31. A passive infra-red detector according to any of the preceding claims and also comprising a housing formed with an aperture adapted for passage therethrough of infra-red radiation, wherein said at least three sub fields-of-view intersect generally at an intersection region located at said aperture, and said aperture is generally equal in size to the size of said intersection region.

32. A passive infra-red detector according to claim 31 and wherein a window transparent to infra-red radiation is located adjacent said aperture.

33. A passive infra-red detector according to claim 32 and wherein a center of said
5 window is located generally at a center of said aperture.

34. A passive infra-red detector according to either of claims 32 and 33 and wherein said window has a circular cross-section.

10 35. A passive infra-red detector according to claim either of claims 32 and 33 and wherein said window is generally flat.

36. A passive infra-red detector according to any of claims 32 to 35 and wherein said window is formed of at least one of HDPE, Silicon and Germanium.

15 37. A passive infra-red detector according to any of claims 32 to 36 and also comprising masking detection functionality for providing an alarm output upon detection of masking materials obstructing said window.

20 38. A passive infra-red detector according to claims any of claims 32 to 37 and also comprising a guard element surrounding said window for providing mechanical protection to said window.

39. A passive infra-red detector comprising:

25 at least three sub-detectors, each of said at least three sub-detectors being operative to receive infra-red radiation from a corresponding one of at least three sub fields-of-view, each of said at least three sub fields-of-view being exclusively defined by an optical element which does not define any other of said at least three sub fields of view, said at least three sub fields-of-view being angled with respect to each other; and
30 reduced false alarm signal processing circuitry, receiving output signals from said at least three sub-detectors and providing a motion detection output and being

operative to eliminate at least some false alarms at least based on sensed time relationships between said output signals.

40. A passive infra-red detector according to claim 39 and wherein said at least
5 three sub fields-of-view are substantially non-overlapping.

41. A passive infra-red detector according to either of claims 39 and 40 and
wherein said signal processing circuitry is operative to process said output signals by
noting time durations of said output signals from adjacent ones of said at least three sub-
10 detectors and providing said motion detection output at least when the ratio between
said time durations is within a predetermined range of values.

42. A passive infra-red detector according to claim 41 and wherein said
predetermined range of values is 0.5 to 2.0.

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43. A passive infra-red detector according to any of claims 39 to 42 and wherein
said signal processing circuitry is operative to process said output signals by noting a
time difference between receipt of said output signals and time durations of said output
signals and to provide said motion detection output if, in response to receipt of said
20 output signals from at least two adjacent ones of said at least three sub-detectors having
respective time durations and a time difference therebetween, said time durations and
said time difference therebetween having a time relationship therebetween which meets
at least one predetermined criterion.

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44. A passive infra-red detector according to claim 43 and wherein said at least one
predetermined criterion comprises whether a ratio between said time difference and at
least one of said time durations lies within a predetermined range of values.

45. A passive infra-red detector according to claim 43 and wherein said at least one
30 predetermined criterion comprises whether ratios between said time difference and each
of said time durations lie within a predetermined range of values.

46. A passive infra-red detector according to either of claims 44 and 45 and wherein said predetermined range of values is based at least in part on divergence angles of at least two zones of two different ones of said at least three sub fields-of-view corresponding to said at least two adjacent ones of said at least three sub-detectors.

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47. A passive infra-red detector according to either of claims 44 and 45 and wherein said predetermined range of values is based at least in part on an angle between at least two zones of two different ones of said at least three sub fields-of-view corresponding to said at least two adjacent ones of said at least three sub-detectors.

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48. A passive infra-red detector according to any of claims 39 to 47 and wherein each said optical element is directed in a corresponding direction, the corresponding directions of said optical elements of each two of said at least three sub-detectors being different.

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49. A passive infra-red detector according to any of claims 39 to 48 and wherein said optical element comprises a non focusing optical element.

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50. A passive infra-red detector according to claim 49 and wherein said non-focusing optical element comprises a reflective optical element.

51. A passive infra-red detector according to any of claims 39 to 48 and wherein said optical element comprises a focusing element.

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52. A passive infra-red detector according to claim 51 and wherein said focusing element comprises at least one of a reflective element, a refractive element, a diffractive element and a cylindrical optical element.

53. A passive infra-red detector comprising:

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at least three sub-detectors, each operative to receive infra-red radiation from a corresponding one of at least three sub fields-of-view, said at least three sub fields-of-

view being substantially non-overlapping and being angled with respect to each other; and

signal processing circuitry, receiving output signals from said at least three sub-detectors and noting time differences between receipt of said output signals from adjacent ones of said at least three sub-detectors and providing a motion detection output in response to receipt of said output signals from said adjacent ones of said at least three sub-detectors having a time difference which is at least within certain predetermined limits.

10 54. A passive infra-red detector comprising:

at least three sub-detectors, each operative to receive infra-red radiation from a corresponding one of at least three sub fields-of-view, said at least three sub fields-of-view being angled with respect to each other; and

15 signal processing circuitry, receiving output signals from at least two adjacent ones of said at least three sub-detectors, noting time durations of said output signals and providing a motion detection output in response to receipt of said output signals from said at least two adjacent ones of said at least three sub-detectors having respective time durations, the ratio of which is within predetermined limits.

20 55. A passive infra-red detector according to claim 54 and wherein said at least three sub fields-of-view are substantially non-overlapping.

56. A passive infra-red detector according to either of claims 54 and 55 and wherein said ratio is within the range of 0.5 to 2.0.

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57. A passive infra-red detector comprising:

at least three sub-detectors, each operative to receive infra-red radiation from a corresponding one of at least three sub fields-of-view, said at least three sub fields-of-view being angled with respect to each other; and

30 signal processing circuitry, receiving output signals from at least two adjacent ones of said at least three sub-detectors, noting time differences between receipt of said output signals and time durations of said output signals and providing a motion

- detection output in response to receipt of said output signals from at least two adjacent ones of said at least three sub-detectors having respective time durations and a time difference therebetween, said time durations and said time difference therebetween having a time relationship therebetween which meets at least one predetermined criterion.
- 5 58. A passive infra-red detector according to claim 59 and wherein said at least three sub fields-of-view are substantially non-overlapping.
- 10 59. A passive infra-red detector according to either of claims 57 and 58 and wherein said at least one predetermined criterion comprises whether a ratio between said time difference and at least one of said time durations lies within a predetermined range of values.
- 15 60. A passive infra-red detector according to either of claims 57 and 58 and wherein said at least one predetermined criterion comprises whether ratios between said time difference and each of said time durations lie within a predetermined range of values.
- 20 61. A passive infra-red detector according to either of claims 59 and 60 and wherein said predetermined range of values is based at least in part on divergence angles of at least two zones of two different ones of said at least three sub fields-of-view corresponding to said at least two adjacent ones of said at least three sub-detectors.
- 25 62. A passive infra-red detector according to either of claims 59 and 60 and wherein said predetermined range of values is based at least in part on an angle between at least two zones of two different ones of said at least three sub fields-of-view corresponding to said at least two adjacent ones of said at least three sub-detectors.
- 30 63. A passive infra-red detector according to any of claims 39 to 62 and wherein said signal processing circuitry is operative to note a sequence of receipt of said output

signals by said at least three sub-detectors and to provide motion direction output based on said sequence.

64. A passive infra-red detector according to any of claims 39 to 62 and wherein
5 said signal processing circuitry is operative to note a sequence of receipt of said output signals by said at least three sub-detectors and to provide motion path output information based on said sequence.

65. A passive infra-red detector according to any of claims 39 to 64 and wherein
10 said passive infra-red detector is operative to receive radiation from a field-of-view having a field-of-view divergence angle of at least 45 degrees.

66. A passive infra-red detector according to any of claims 39 to 65 and wherein at
least one of said at least three sub fields-of-view comprises a single coplanar
15 azimuthally distributed detection zone.

67. A passive infra-red detector according to any of claims 39 to 66 and wherein at
least one of said at least three sub fields-of-view comprises multiple coplanar
azimuthally distributed detection zones.

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68. A passive infra-red detector according to any of claims 39 to 67 and wherein at
least one of said at least three sub fields-of-view comprises a single vertically
distributed detection zone.

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69. A passive infra-red detector according to any of claims 39 to 68 and wherein at
least one of said at least three sub fields-of-view comprises multiple vertically
distributed detection zones.

70. A passive infra-red detector according to any of claims 66 to 69 and wherein
30 adjacent ones of said at least three sub fields-of-view are separated by a gap of no more
than 30 degrees.

71. A passive infra-red detector according to claim 67 and wherein said azimuthally distributed detection zones have corresponding divergence angles and said gap has an angular extent which is less than or equal to twice the largest angular extent of said divergence angles of detection zones of said adjacent ones of said at least three
5 sub fields-of-view.

72. A passive infra-red detector according to claim 70 and wherein said gap has an angular extent which is less than or equal to a largest azimuthal angle $A - 2B$ between any two adjacent detection zones of said adjacent ones of said at least three sub fields-
10 of-view.

73. A passive infra-red detector according to any of claims 39 to 72 and also comprising a housing formed with an aperture adapted for passage therethrough of infra-red radiation, wherein said at least three sub fields-of-view intersect generally at
15 an intersection region located at said aperture, and said aperture is generally equal in size to the size of said intersection region.

74. A passive infra-red detector according to claim 73 and wherein a window transparent to infra-red radiation is located adjacent said aperture.
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75. A passive infra-red detector according to claim 74 and wherein a center of said window is located generally at a center of said aperture.

76. A passive infra-red detector according to either of claims 74 and 75 and
25 wherein said window has a circular cross-section.

77. A passive infra-red detector according to either of claims 74 and 75 and wherein said window is generally flat.

30 78. A passive infra-red detector according to any of claims 74 to 77 and wherein said window is formed of at least one of HDPE, Silicon and Germanium.

79. A passive infra-red detector according to any of claims 74 to 78 and also comprising masking detection functionality for providing an alarm output upon detection of masking materials obstructing said window.

5 80. A passive infra-red detector according to claims any of claims 74 to 79 and also comprising a guard element surrounding said window for providing mechanical protection to said window.

10 81. A passive infra-red detector having a field-of-view including multiple detection zones, said detector comprising:

a housing having an aperture for passage of infra-red radiation therethrough;
at least one sensor disposed in said housing; and
at least one infra-red radiation director including a plurality of infra-red optical elements each associated with a different one of said multiple detection zones, each of 15 said plurality of infra-red optical elements being operative to receive infra-red radiation from a corresponding one of said multiple detection zones and to direct said infra-red radiation to said at least one sensor along a corresponding radiation path, a plurality of said radiation paths generally intersecting at an intersection region located at said aperture, said aperture being generally of the same size as the size of said intersection 20 region.

82. A passive infra-red detector according to claim 81 and wherein at least one of said plurality of optical elements comprises at least one non-focusing optical element.

25 83. A passive infra-red detector according to claim 82 and wherein said at least one non-focusing element comprises at least one reflective optical element.

84. A passive infra-red detector according to claim 81 and wherein at least one of said plurality of optical elements comprises at least one focusing element.

85. A passive infra-red detector according to claim 84 and wherein said at least one focusing element comprises at least one of a reflective element, a refractive element, a diffractive element and a cylindrical optical element.

5 86. A passive infra-red detector according to any of claims 81 to 85 and also comprising a window transparent to infra-red radiation, located adjacent said aperture.

87. A passive infra-red detector according to claim 86 and wherein a center of said window is located generally at a center of said aperture.

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88. A passive infra-red detector according to either of claims 86 and 87 and wherein said window has a circular cross-section.

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89. A passive infra-red detector according to claim either of claims 86 and 87 and wherein said window is generally flat.

90. A passive infra-red detector according to any of claims 86 to 89 and wherein said window is formed of at least one of HDPE, Silicon and Germanium.

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91. A passive infra-red detector according to any of claims 86 to 90 and also comprising masking detection functionality for providing an alarm output upon detection of masking materials obstructing said window.

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A passive infra-red detector according to claim 91 and wherein each of said multiple detection zones includes a non-masked portion when masking materials are applied to part of said window.

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A passive infra-red detector according to claims any of claims 86 to 92 and also comprising a guard element surrounding said window for providing mechanical protection to said window.

94. A passive infra-red detector according to any of claims 81 to 93 and also comprising at least one intermediate reflecting surface located along an optical path defined by said infra-red radiation director at a location suitable for redirecting radiation from said infra-red radiation director to said radiation sensor.

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95. A radiation detector comprising:

a housing defining an elongate radiation receiving slit aperture lying along a slit axis;

10 a radiation sensor disposed within said housing along said slit axis at a location spaced from said elongate radiation receiving slit aperture; and

a radiation reflecting surface arranged to receive radiation passing through said elongate radiation receiving slit aperture and to focus said radiation on said radiation sensor, said radiation reflecting surface being defined at least partially by rotation through a rotation angle about said slit axis of a portion of a parabola, whose axis of symmetry extends perpendicularly to said slit axis through said radiation sensor.

15 96. A radiation detector comprising:

a housing defining an elongate radiation receiving slit aperture lying along a slit axis;

20 a radiation sensor disposed within said housing at a location spaced from said elongate radiation receiving slit aperture; and

a radiation reflecting surface arranged to receive radiation passing through said elongate radiation receiving slit aperture and to focus said radiation on said radiation sensor, said radiation reflecting surface being defined at least partially by rotation through a rotation angle about said slit axis of a portion of a parabola, whose axis of symmetry extends perpendicularly to said slit axis.

25 97. A radiation detector according to either of claims 95 and 96 and wherein said rotation angle is 90 degrees.

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98. A radiation detector according to any of claims 95 to 97 and being operative such that when said slit axis is a horizontal axis, said rotation angle defines the angular extent of a radiation receiving curtain in a vertical plane.
- 5 99. A radiation detector according to any of claims 95 to 98 and also comprising at least one intermediate reflecting surface located along an optical path defined by said radiation reflecting surface at a location suitable for redirecting radiation from said radiation reflecting surface to said radiation sensor.
- 10 100. A radiation detector according to any of claims 95 to 99 and also comprising a window transparent to infra-red radiation, located adjacent said radiation receiving slit aperture.
- 15 101. A radiation detector according to claim 100 and wherein a center of said window is located generally at a center of said radiation receiving slit aperture.
102. A radiation detector according to either of claims 100 and 101 and wherein said window has a circular cross-section.
- 20 103. A radiation detector according to either of claims 100 and 101 and wherein said window is generally flat.
104. A radiation detector according to either of claims 101 and 103 and wherein said window does not have optical power and does have varying thickness, thereby providing varying radiation attenuation.
- 25 105. A radiation detector according to claim 104 and wherein said varying radiation attenuation provides pet immunity.
- 30 106. A radiation detector according to any of claims 100 to 105 and wherein said window is formed of at least one of HDPE, Silicon and Germanium.

107. A radiation detector according to any of claims 95 to 106 and wherein said radiation reflecting surface includes a plurality of reflecting surface areas corresponding to a plurality of radiation receiving areas, wherein different ones of said plurality of reflecting surface areas have different widths, thereby providing different sensitivity of
5 said radiation sensor at corresponding ones of said plurality of radiation receiving areas.

108. A radiation detector according to claim 107 and wherein said different sensitivity of said radiation sensor at corresponding ones of said plurality of radiation receiving areas provides pet immunity.

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109. A radiation detector according to any of claims 95 to 108 and wherein said radiation sensor is operative to view a field-of-view comprising a curtain-like field-of-view.

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110. A radiation detector according to claim 109 and wherein said curtain-like field-of-view extends generally through 90 degrees.

111. A radiation detector according to claim 110 and wherein said curtain-like field-of-view extends generally through 90 degrees from the vertical to the horizontal.

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112. A radiation detector comprising:

a housing defining a radiation receiving slit aperture; and

an optical system disposed within said housing defining a field-of-view and including:

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at least one radiation reflecting surface arranged to receive radiation passing through said radiation receiving slit aperture and to focus said radiation on a radiation sensor disposed in said housing, said at least one radiation reflecting surface being defined by a collection of curves disposed along an ellipse, said ellipse having a first focus and a second focus along a principal axis thereof, said at least one radiation reflecting surface defining a slit axis which passes through said second focus and said slit aperture, each of said curves being defined by the intersection at a point on the ellipse, of a slit axis plane which includes the slit axis and a focusing surface whose

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focus is at said first focus and which has an axis of symmetry which is parallel to said slit axis plane.

113. A radiation detector comprising:

5 a housing defining a radiation receiving slit aperture; and
an optical system disposed within said housing defining a field-of-view and
including:

10 at least one radiation reflecting surface arranged to receive radiation
passing through said radiation receiving slit aperture and to focus said radiation on a
radiation sensor disposed in said housing, said at least one radiation reflecting surface
being defined by a collection of curves disposed along at least one ellipse, said at least
one ellipse lying in the same plane and having a common first focus and a common
second focus along a principal common axis thereof, said at least one radiation
reflecting surface defining a slit axis which passes through said second focus and said
15 slit aperture, each of said curves being defined by the intersection at a point on the at
least one ellipse, of a slit axis plane which includes the slit axis and a focusing surface
whose focus is at said first common focus and which has an axis of symmetry which is
parallel to said slit axis plane.

20 114. A radiation detector according to either of claims 112 and 113 and wherein
said slit axis is generally perpendicular to said principal axis.

115. A radiation detector according to any of claims 112 to 114 and wherein said
focusing surface comprises at least one of a parabolic focusing surface, a spherical
25 focusing surface and an aspheric focusing surface.

116. A radiation detector comprising:

a housing defining a radiation receiving slit aperture; and
an optical system disposed within said housing defining a field-of-view and
30 including:

at least one radiation reflecting surface arranged to receive radiation
passing through said radiation receiving slit aperture and to focus said radiation on a

radiation sensor disposed in said housing, said at least one radiation reflecting surface comprising at least one radiation reflecting surface segment curved in at least two mutually orthogonal planes, each of said at least one radiation reflecting surface segment being defined by an array of curves which intersect an ellipse having a first focus at a first common focus point and a second focus in the vicinity of said slit aperture, each of said array of curves being focused at said first focus of said ellipse.

5 117. A radiation detector according to claim 116 and wherein each of said array of curves comprises at least one of a parabolic curve, a spherical curve and an aspheric 10 curve.

118. A radiation detector according to any of claims 112 to 117 and wherein said radiation sensor is located at said first focus.

15 119. A radiation detector according to any of claims 112 to 118 and also comprising at least one intermediate reflecting surface located along an optical path defined by said at least one radiation reflecting surface at a location suitable for redirecting radiation from said at least one radiation reflecting surface to said radiation sensor.

20 120. A radiation detector according to any of claims 112 to 119 and wherein said field-of-view comprises a curtain-like field-of-view.

121. A radiation detector according to claim 120 and wherein said curtain like field-of-view extends generally through 90 degrees.

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122. A radiation detector according to claim 121 and wherein said curtain like field-of-view extends generally through 90 degrees from the vertical to the horizontal.

30 123. A radiation detector according to any of claims 112 to 122 and also comprising a window transparent to infra-red radiation, located adjacent said radiation receiving slit aperture.

124. A radiation detector according to claim 123 and wherein a center of said window is located generally at a center of said radiation receiving slit aperture.

125. A radiation detector according to either of claims 123 and 124 and wherein
5 said window has a circular cross-section.

126. A radiation detector according to either of claims 123 and 124 and wherein said window is generally flat.

10 127. A radiation detector according to either of claims 125 and 126 and wherein said window does not have optical power and does have varying thickness, thereby providing varying radiation attenuation.

15 128. A radiation detector according to claim 127 and wherein said varying radiation attenuation provides pet immunity.

129. A radiation detector according to any of claims 123 to 128 and wherein said window is formed of at least one of HDPE, Silicon and Germanium.

20 130. A radiation detector according to any of claims 112 to 129 and wherein said at least one radiation reflecting surface includes a plurality of reflecting surface areas corresponding to a plurality of radiation receiving areas, wherein different ones of said plurality of reflecting surface areas have different widths thereby providing different sensitivity of said radiation sensor at corresponding ones of said plurality of radiation receiving areas.
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131. A radiation detector according to claim 130 and wherein said different sensitivity of said radiation sensor at corresponding ones of said plurality of radiation receiving areas provides pet immunity.

30 132. A radiation detector according to any of claims 112 to 131 and wherein said slit aperture has a height in the range of 2-5 mm.

133. A radiation detector comprising:

a housing defining an elongate radiation receiving slit aperture through which extend a first plurality of slit axes, each of said plurality of slit axes passing through a common first focus of a second plurality of ellipses having a common second focus, said common first focus and said common second focus lying along a common primary axis of symmetry;

a radiation sensor disposed within said housing; and

10 a radiation reflecting surface arranged to receive radiation passing through said elongate radiation receiving slit aperture and to focus said radiation on said radiation sensor, said radiation reflecting surface comprising a first plurality of radiation reflecting surface segments, each of said first plurality of radiation reflecting surface segments including a segment surface curved in at least two mutually orthogonal planes, each said segment surface including a portion of at least one of said second plurality of 15 ellipses and being defined by a continuous array of curves which join said portion of said at least one of said second plurality of ellipses, said continuous array of curves being focused at said common second focus of said second plurality of ellipses.

134. A radiation detector according to claim 133 and wherein each of said array of 20 curves comprises at least one of a parabolic curve, a spherical curve and an aspheric curve.

135. A radiation detector according to either of claims 133 and 134 and wherein said radiation sensor is located at said common second focus of said second plurality of 25 ellipses.

136. A radiation detector according to either of claims 133 and 134 and also comprising at least one intermediate reflecting surface located along an optical path defined by said radiation reflecting surface at a location suitable for redirecting radiation 30 from said radiation reflecting surface to said radiation sensor.

137. A radiation detector according to any of claims 133 to 136 and wherein said first plurality of slit axes are generally perpendicular to said common primary axis of symmetry.

5 138. A radiation detector according to any of claims 133 to 137 and wherein said radiation reflecting surface defines a plurality of curtain-like detection zones.

139. A radiation detector according to claim 138 and wherein each of said plurality of curtain like detection zones extends generally through 90 degrees.

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140. A radiation detector according to claim 139 and wherein each of said plurality of curtain like detection zones extends generally through 90 degrees from the vertical to the horizontal.

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141. A radiation detector according to any of claims 133 to 140 and also comprising a window transparent to infra-red radiation, located adjacent said radiation receiving slit aperture.

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142. A radiation detector according to claim 141 and wherein a center of said window is located generally at a center of said radiation receiving slit aperture.

143. A radiation detector according to either of claims 141 and 142 and wherein said window has a circular cross-section.

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144. A radiation detector according to either of claims 141 and 142 and wherein said window is generally flat.

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145. A radiation detector according to either of claims 143 and 144 and wherein said window does not have optical power and does have varying thickness, thereby providing varying radiation attenuation.

146. A radiation detector according to claim 145 and wherein said varying radiation attenuation provides pet immunity.

147. A radiation detector according to any of claims 141 to 146 and wherein said
5 window is formed of at least one of HDPE, Silicon and Germanium.

148. A radiation detector according to any of claims 133 to 147 and wherein said
radiation reflecting surface includes a plurality of reflecting surface areas corresponding
to a plurality of radiation receiving areas, wherein different ones of said plurality of
10 reflecting surface areas have different widths thereby providing different sensitivity of
said radiation sensor at corresponding ones of said plurality of radiation receiving areas.

149. A radiation detector according to claim 148 and wherein said different
sensitivity of said radiation sensor at corresponding ones of said plurality of radiation
15 receiving areas provides pet immunity.

150. A radiation detector according to any of claims 141 to 147 and wherein said
window has a height in the range of 2-5 mm.

20 151. A passive infra-red detector comprising:

at least two sub-detectors each operative to receive infra-red radiation from a
corresponding one of at least two sub fields-of-view; and

25 signal processing circuitry, receiving output signals from said at least two sub-
detectors and noting time relationships of said output signals from said at least two sub-
detectors and providing a motion detection output in response to receipt of said output
signals from said at least two sub-detectors having a time relationship which meets at
least one predetermined criterion,

at least one of said at least one predetermined criterion being time duration of
at least one of said output signals.

30

152. A passive infra-red detector according to claim 151 and wherein two of said at
least two sub-detectors have substantial horizontal separation therebetween.

153. A passive infra-red detector according to claim 152 and wherein said at least one predetermined criterion is based at least in part on the extent of said substantial horizontal separation.

5

154. A passive infra-red detector according to any of claims 151 to 153 and wherein said at least two sub-detectors are angled with respect to each other by a horizontal separation angle and said at least one predetermined criterion is based at least in part on the extent of said horizontal separation angle.

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155. A passive infra-red detector according to any of claims 151 to 154 and wherein each of said at least two sub-fields-of-view includes at least one detection zone which diverges by a corresponding horizontal divergence angle and said at least one predetermined criterion is based at least in part on the extent of said horizontal divergence angles.

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156. A passive infra-red detector according to any of claims 151 to 155 and wherein said at least one predetermined criterion comprises at least one of:

whether a time duration of at least one of said output signals lies within a predetermined range of values;

whether a time duration between receipt of a first output signal from a first one of said at least two sub-detectors and receipt of a second output signal from a second one of said at least two sub-detectors lies within a predetermined range of values;

whether a ratio of a first time duration of said first output signal and a second time duration of said second output signal lies within a predetermined range of values;

whether a ratio of said first time duration of said first output signal and said time duration between receipt of a first output signal from a first one of said at least two sub-detectors and receipt of a second output signal from a second one of said at least two sub-detectors lies within a predetermined range of values; and

whether a ratio of said second time duration of said second output signal and said time duration between receipt of a first output signal from a first one of said at least

two sub-detectors and receipt of a second output signal from a second one of said at least two sub-detectors lies within a predetermined range of values.

157. A passive infra-red detector according to any of claims 151 to 156 and wherein
5 said signal processing circuitry utilizes said time relationships of said output signals from said at least two sub-detectors to compute a speed of motion of an intruder generating said output signals and provides said motion detection output if said speed of motion is within a predetermined speed range.
- 10 158. A passive infra-red detector according to claim 157 and wherein said predetermined speed range is between 0.1 to 3 meters per second.
159. A passive infra-red detector according to any of claims 154 to 158 and wherein
15 said signal processing circuitry utilizes said time relationships of said output signals from said at least two sub-detectors to compute a distance from the detector of an intruder generating said output signals and provides said motion detection output if said distance is within a predetermined distance range.
160. A passive infra-red detector according to claim 159 and wherein said signal
20 processing circuitry utilizes the extent of at least one of said substantial horizontal separation between said at least two sub-detectors; said horizontal separation angle between said at least two sub fields-of-view and a divergence angle of at least one detection zone of at least one of said at least two sub fields-of-view to compute said distance and provides said motion detection output if said distance is within said
25 predetermined distance range.
161. A passive infra-red detector according to any of claims 151 to 160 and wherein
said signal processing circuitry utilizes said time relationships of said output signals from said at least two sub-detectors to compute a ratio representing an extent of change
30 in a speed of motion of an intruder generating said output signals of said at least two sub-detectors and provides said motion detection output if said ratio, representing said

extent of change in said speed of motion of said intruder, is within a predetermined ratio range.

162. A passive infra-red detector according to any of claims 151 to 161 and wherein
5 said signal processing circuitry utilizes said time relationships of said output signals from said at least two sub-detectors to compute a ratio $(t_1/t_2)/(Z_0/t/K)$ representing an extent of change in a speed of motion of an intruder generating said output signals of said at least two sub-detectors and provides said motion detection output if said ratio $(t_1/t_2)/(Z_0/t/K)$ is within a predetermined ratio range.

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163. A passive infra-red detector according to either of claims 161 and 162 and wherein said predetermined ratio range is within at least one of the ranges 0.7 to 1.5 and 0.8 to 1.3.

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164. A passive infra-red detector according to any of claims 151 to 163 and wherein at least one of said at least two sub fields-of-view comprises a curtain-like sub field-of-view.

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165. A radiation detector according to claim 164 and wherein said curtain-like sub field-of-view extends generally through 90 degrees.

166. A radiation detector according to claim 165 and wherein said curtain-like sub field-of-view extends generally through 90 degrees from the vertical to the horizontal.

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167. A passive infra-red detector according to any of claims 151 to 166 and wherein at least one of said at least two sub fields-of-view comprises a non-curtain like sub field-of-view.

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168. A passive infra-red detector according to any of claims 151 to 167 and wherein at least one of said at least two sub-detectors includes a single element sensor.

169. A passive infra-red detector according to any of claims 151 to 168 and wherein at least one of said at least two sub-detectors includes a multiple element sensor.

170. A passive infra-red detector according to any of claims 151 to 169 and wherein
5 said signal processing circuitry also includes a traversal logic functionality, which provides an alarm enabling signal based at least in part on a direction of traversal of said at least two sub fields-of-view, and provides said motion detection output based at least in part on said alarm enabling signal.

10 171. A passive infra-red detector according to claim 170 and wherein said traversal logic functionality provides said alarm enabling signal if at least one of said at least two sub fields-of-view was traversed.

15 172. A passive infra-red detector according to either of claims 170 and 171 and wherein said traversal logic functionality provides said alarm enabling signal if at least two of said at least two sub fields-of-view were traversed.

20 173. A passive infra-red detector according to claim 172 and wherein said traversal logic functionality provides said alarm enabling signal if at least two of said at least two sub fields-of-view were traversed in a first direction and were not traversed in a second direction, generally opposite to said first direction.

174. A passive infra-red detector according to any of claims 170 to 173 and wherein said traversal logic functionality provides said alarm enabling signal if at least two of said at least two sub fields-of-view were traversed in a first direction at least a predetermined time following traversal of said at least two sub fields-of-view in a second direction, generally opposite to said first direction.
25

175. A passive infra-red detector comprising:
30 at least two sub-detectors, each operative to receive infra-red radiation from a corresponding one of at least two sub fields-of-view; and

signal processing circuitry, receiving output signals from said at least two sub-detectors and noting time relationships of said output signals from said at least two sub-detectors and providing a motion detection output in response to receipt of said output signals from said at least two sub-detectors, representing traversal of said at least two
5 sub fields-of-view, having a time relationship which meets at least one predetermined criterion,

at least one of said at least one predetermined criterion being traversal of said
at least two sub fields-of-view in a first direction at least a predetermined time following
traversal of said at least two sub fields-of-view in a second direction, generally opposite
10 to said first direction.

176. A passive infra-red detector according to claim 175 and wherein said signal
processing circuitry selectively provides at least one of a visual indication and an audible
indication during said predetermined time.

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177. A passive infra-red detector according to claim 176 and wherein said signal
processing circuitry selectively provides both said visual indication and said audible
indication during said predetermined time.

20 178. A passive infra-red detector according to any of claims 175 to 177 and wherein
said predetermined time is defined by a user.

179. An intrusion detector comprising:
a housing; and
25 at least first and second passive infra-red detectors disposed in said housing,
each being adapted for providing a separate detector output to an external alarm
controller, each of said first and second passive infra-red detectors having a plurality of
detection zones, said detection zones of said first passive infra-red detector being non-
overlapping with said detection zones of said second passive infra-red detector,
30 detection zones of said first passive infra-red detector being azimuthally interlaced with
detection zones of said second passive infra-red detector.

180. An intrusion detector according to claim 179 and wherein said at least first and second passive infra-red detectors are arranged to provide coverage over generally the same azimuthal detection region.

5 181. An intrusion detector according to either of claims 179 and 180 and wherein individual detection zones of said first passive infra-red detector are each located intermediate a pair of individual detection zones of said second passive infra-red detector.

10 182. An intrusion detector according to any of claims 179 to 181 and wherein individual detection zones of said second passive infra-red detector are each located intermediate a pair of individual detection zones of said first passive infra-red detector.

15 183. An intrusion detector according to any of claims 180 to 182 and wherein said detection zones of said first passive infra-red detector are azimuthally interlaced with detection zones of said second passive infra-red detector at least at a central portion of said azimuthal detection region.

184. An intrusion detector according to any of claims 179 to 183 and wherein said detection zones of said first passive infra-red detector are azimuthally interlaced with detection zones of said second passive infra-red detector in a pattern such that interference confined to one detection zone of said first passive infra-red detector is not sensed by an adjacent detection zone of said second passive infra-red detector.

25 185. An intrusion detector according to any of claims 179 to 184 and also comprising:

at least first and second signal processing circuits associated with each of said at least first and second passive infra-red detectors; and

30 at least first and second output relays associated with said first and second signal processing circuits and being operative to provide said separate detector outputs to said external alarm controller.

186. An intrusion detector according to claim 185 and wherein said at least first and second output relays are operative to provide said separate detector outputs to said external alarm controller via corresponding at least first and second connection wires.

5 187. An intrusion detector according to claim 185 and wherein said at least first and second output relays comprise at least first and second wireless output transmitters.

10 188. An intrusion detector according to any of claims 185 to 187 and wherein one of said at least first and second signal processing circuits is operative to generate a detection output signal and to provide said detection output signal to said external alarm controller only if another of said at least first and second signal processing circuits detects motion within a predetermined time separation with respect to the generation of said detection output signal by said one of said at least first and second signal processing circuits.

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189. An intrusion detector according to any of claims 185 to 187 and wherein one of said at least first and second signal processing circuits is operative to generate a detection output signal and to provide said detection output signal to said external alarm controller only if another of said at least first and second signal processing circuits generates a detection output signal within a predetermined time separation with respect to the generation of said detection output signal by said one of said at least first and second signal processing circuits.

20 190. An intrusion detector according to any of claims 187 to 189 and wherein one of said at least first and second signal processing circuits is operative to generate a detection output signal and to provide said detector output signal to said external alarm controller only if another of said at least first and second signal processing circuits does not simultaneously generate a detection output signal.

30 191. An intrusion detector according to any of claims 185 to 190 and wherein said at least first and second signal processing circuits are operative to provide a common detection output signal to said external alarm controller.

192. An intrusion detector according to any of claims 179 to 191 and wherein each of said plurality of detection zones comprises a plurality of finger-like regions.

5 193. An intrusion detector according to claim 192 and wherein said plurality of finger-like regions comprises four finger-like regions.

10 194. An intrusion detector according to any of claims 179 to 193 and wherein each of said plurality of detection zones comprises a pair of vertically separated detection zones.

195. An intrusion detector according to claim 194 and wherein at least one of said pair of vertically separated detection zones comprises a curtain-like detection zone.

15 196. An intrusion detector according to claim 179 to 193 and wherein each of said plurality of detection zones comprises a single vertically distributed curtain-like detection zone.

20 197. An intrusion detector according to any of claims 179 to 196 and wherein said plurality of detection zones is defined by a corresponding plurality of optical elements.

198. An intrusion detector according to claim 197 and wherein at least one of said corresponding plurality of optical elements comprises at least one non- focusing optical element.

25 199. An intrusion detector according to claim 198 and wherein said at least one non-focusing optical element comprises at least one reflective optical element.

200. An intrusion detector according to claim 197 and wherein at least one of said corresponding plurality of optical elements comprises at least one focusing element.

201. An intrusion detector according to claim 200 and wherein said at least one focusing element comprises at least one of a reflective element, a refractive element, a diffractive element and a cylindrical optical element.

5 202. A passive infra-red detector having a field-of-view including multiple detection zones, said detector comprising:

 a housing adapted for mounting adjacent a ceiling of a room and having at least one aperture for passage of infra-red radiation therethrough;

 at least one sensor disposed in said housing; and

10 at least one infra-red radiation director including a plurality of infra-red optical elements associated with corresponding ones of said multiple detection zones, each of said plurality of infra-red optical elements being operative to receive infra-red radiation from at least one of said multiple detection zones and to direct said infra-red radiation to said at least one sensor along a corresponding radiation path, a plurality of said radiation paths generally intersecting at an intersection region located at said at least one aperture, said at least one aperture being generally of the same size as the size of said intersection region.

203. A passive infra-red detector having a field-of-view including multiple detection zones, said detector comprising:

 a housing adapted for mounting adjacent a ceiling of a room and having at least one aperture for passage of infra-red radiation therethrough;

 at least one sensor disposed in said housing; and

25 at least one infra-red radiation director including multiple infra-red optical elements, each of said multiple detection zones being exclusively defined by one of said multiple infra-red optical elements which does not define any other of said multiple detection zones; said multiple infra-red optical elements being operative to receive infra-red radiation from said multiple detection zones and to direct said infra-red radiation to said at least one sensor along a corresponding radiation path, a plurality of said radiation paths generally intersecting at an intersection region located at said at least one aperture, said at least one aperture being generally of the same size as said intersection region.

204. A passive infra-red detector according to either of claims 202 and 203 and wherein said housing includes a first housing surface adapted to lie generally parallel to said ceiling and said at least one aperture is formed in a second housing surface 5 extending generally parallel to said first housing surface.
205. A passive infra-red detector according to any of claims 202 to 204 and wherein said at least one aperture comprises a plurality of apertures and wherein said at least one sensor comprises a single sensor.
- 10
206. A passive infra-red detector according to any of claims 202 to 204 and wherein said at least one aperture comprises a first plurality of apertures and wherein said at least one sensor comprises a number of sensors which is less than said first plurality.
- 15 207. A passive infra-red detector according to any of claims 202 to 204 and wherein said at least one aperture comprises a first plurality of apertures, said at least one sensor comprises a first plurality of sensors and infra-red radiation received by each of said first plurality of sensors is directed through a different one of said first plurality of apertures.
- 20
208. A passive infra-red detector according to any of claims 202 to 204 and wherein said at least one aperture comprises a single aperture and wherein said at least one sensor comprises a single sensor.
- 25 209. A passive infra-red detector according to claim 208 and wherein said housing is adapted for mounting adjacent said ceiling in a corner of said room.
210. A passive infra-red detector according to any of claims 202 to 209 and wherein at least one of said plurality of infra-red optical elements comprises a non focusing 30 optical element.

211. A passive infra-red detector according to claim 210 and wherein said non-focusing element is a reflective optical element.

212. A passive infra-red detector according to claim any of claims 202 to 211 and
5 wherein at least one of said plurality of infra-red optical elements comprises a focusing element.

213. A passive infra-red detector according to claim 212 and wherein said focusing element comprises at least one of a reflective element, a refractive element, a diffractive
10 element and a cylindrical optical element.

214. A passive infra-red detector according to any of claims 202 to 213 and also comprising a window transparent to infra-red radiation, located adjacent said at least one aperture.

15

215. A passive infra-red detector according to claim 214 and wherein a center of said window is located generally at a center of said at least one aperture.

216. A passive infra-red detector according to either of claims 214 and 215 and
20 wherein said window has a circular cross-section.

217. A passive infra-red detector according to either of claims 214 and 215 and wherein said window is generally flat.

25 218. A passive infra-red detector according to any of claims 214 to 217 and wherein said window is formed of at least one of HDPE, Silicon and Germanium.

219. A passive infra-red detector according to any of claims 214 to 218 and also comprising masking detection functionality for providing an alarm output upon
30 detection of masking materials obstructing said window.

220. A passive infra-red detector according to claims any of claims 214 to 219 and also comprising a guard element surrounding said window for providing mechanical protection to said window.

5 221. A passive infra-red detector according to any of claims 202 to 220 and also comprising at least one intermediate reflecting surface located along an optical path defined by said at least one infra-red radiation director at a location suitable for redirecting radiation from said at least one infra-red radiation director to said at least one sensor.

10

222. A passive infra-red detector according to claim 221 and wherein said at least one intermediate reflecting surface comprises a single hyperbolic reflecting surface.